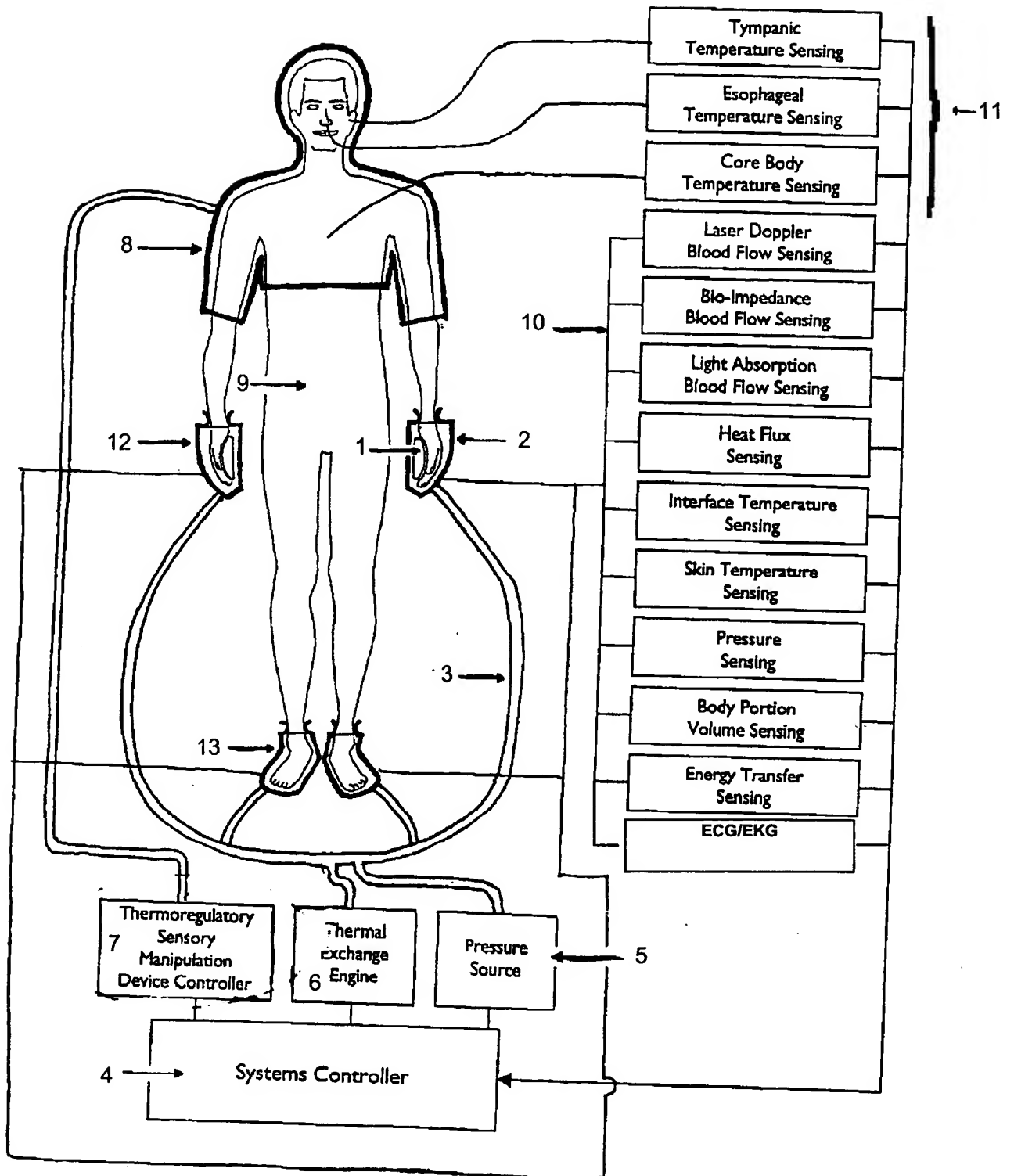


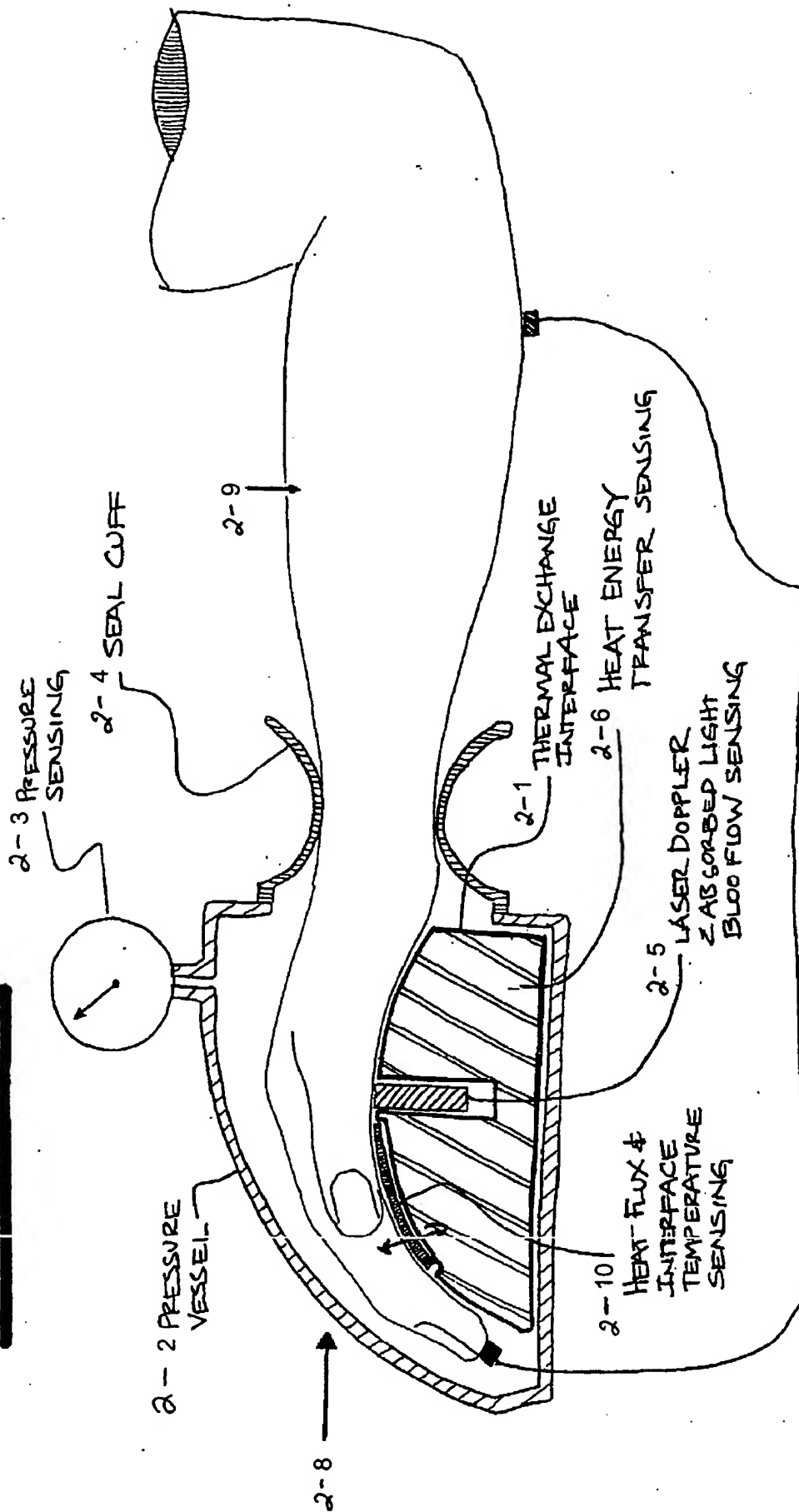
Figure 1

System Architecture



HAND INTERFACE & RELATED SENSORS

Figure 2



FOOT INTERFACE & RELATED SENSORS

Figure 3

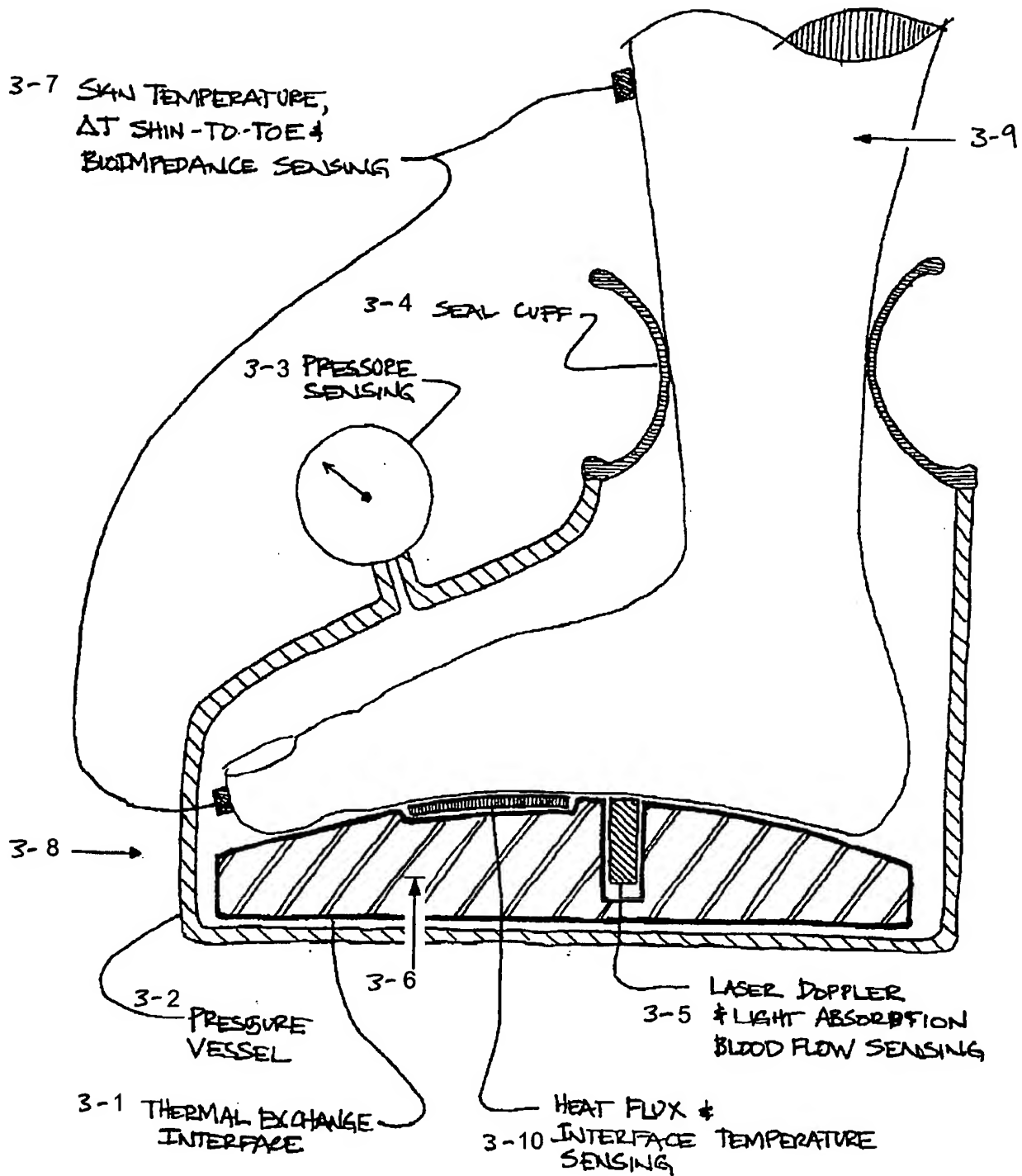
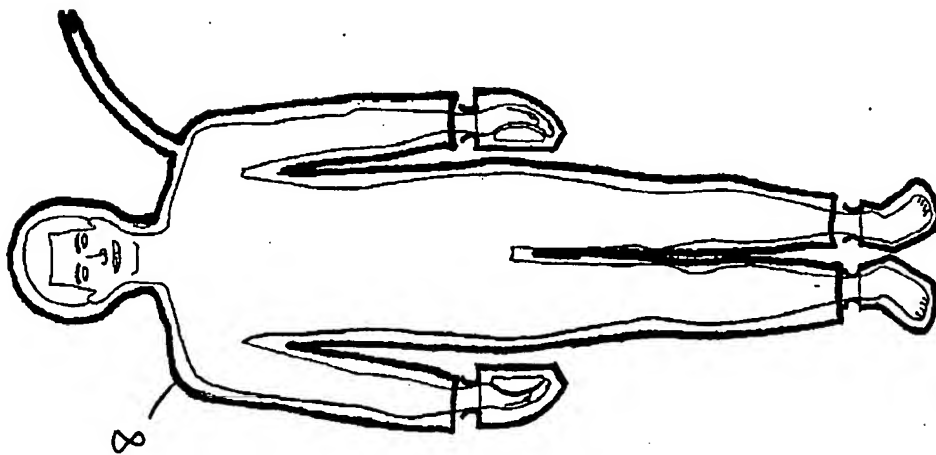
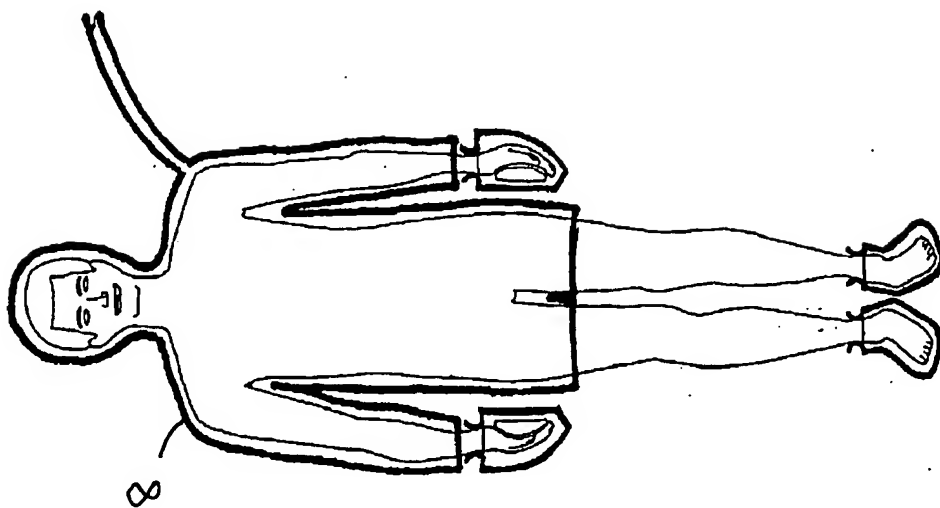


Figure 4

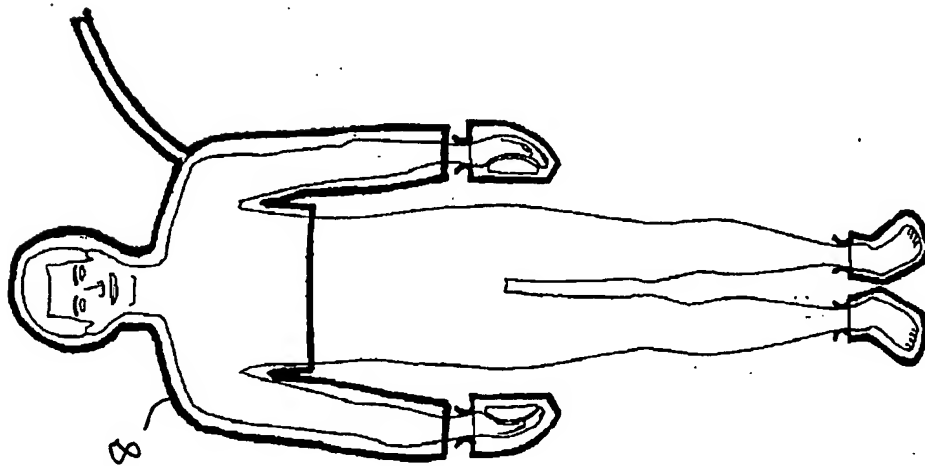
4a. THE ENTIRE SKIN SURFACE



4b. HEAD SHOULDERS, CHEST, BACK
TORSO & ARMS



4c. HEAD SHOULDERS, CHEST,
BACK & ARMS



4d. HEAD, SHOULDERS, CHEST & BACK

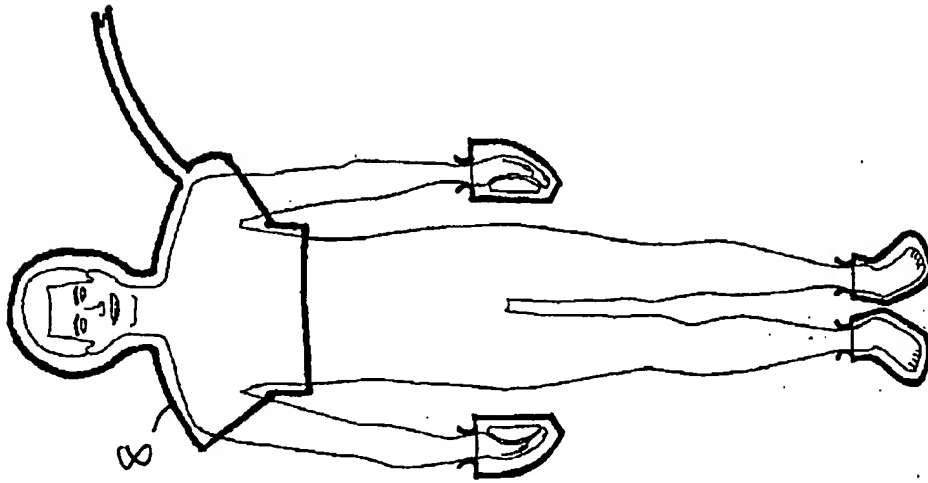
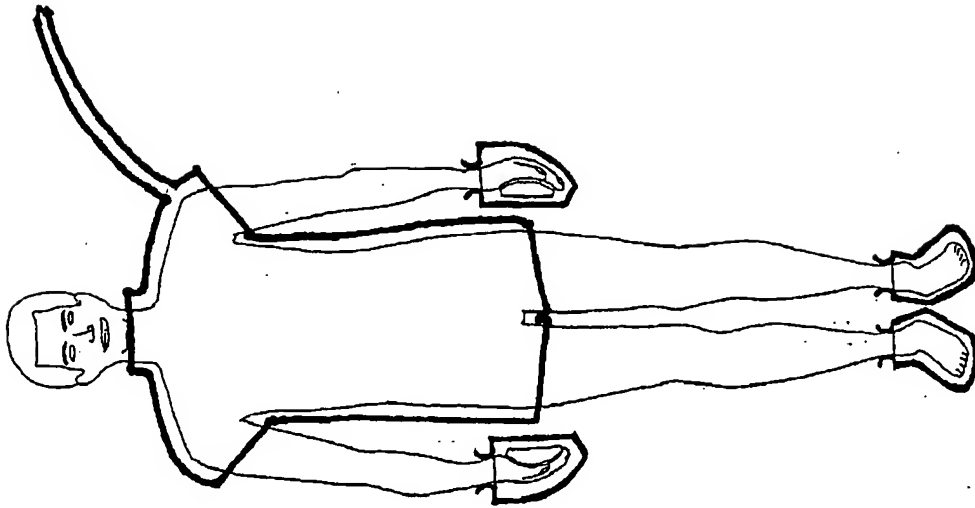


Figure 4, Cont.

Figure 4, Cont.

4f. SHOULDERS, CHEST, BACK & DRSD



4e. SHOULDERS, CHEST, BACK & ARMS

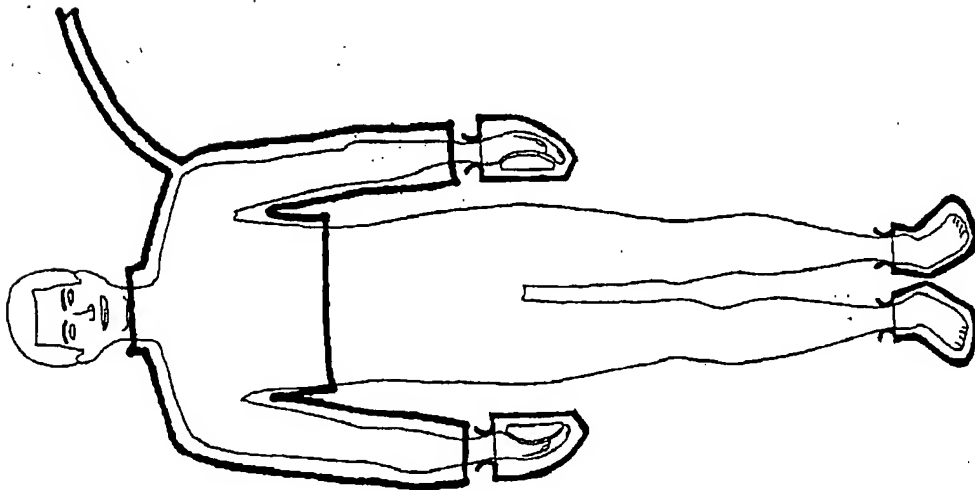
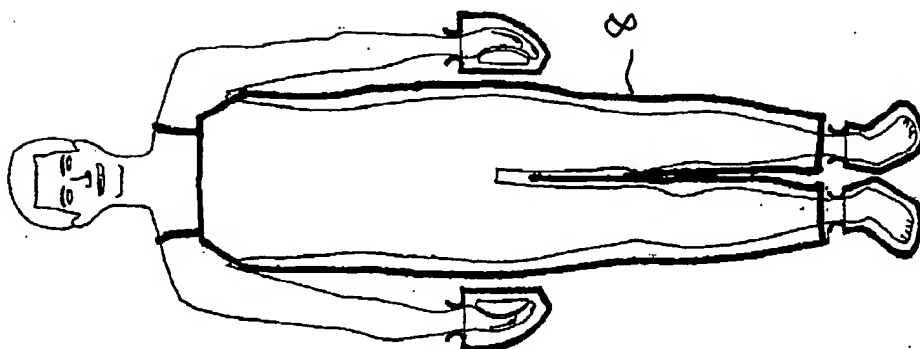


Figure 4, Cont.

4g. CHEST, BACK, TORSO, & LEGS



4h. TORSO & LEGS

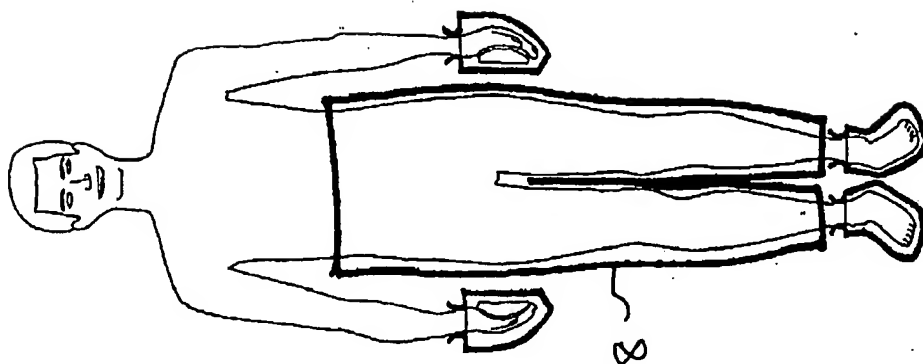


Figure 5

Control Algorithm - Cooling

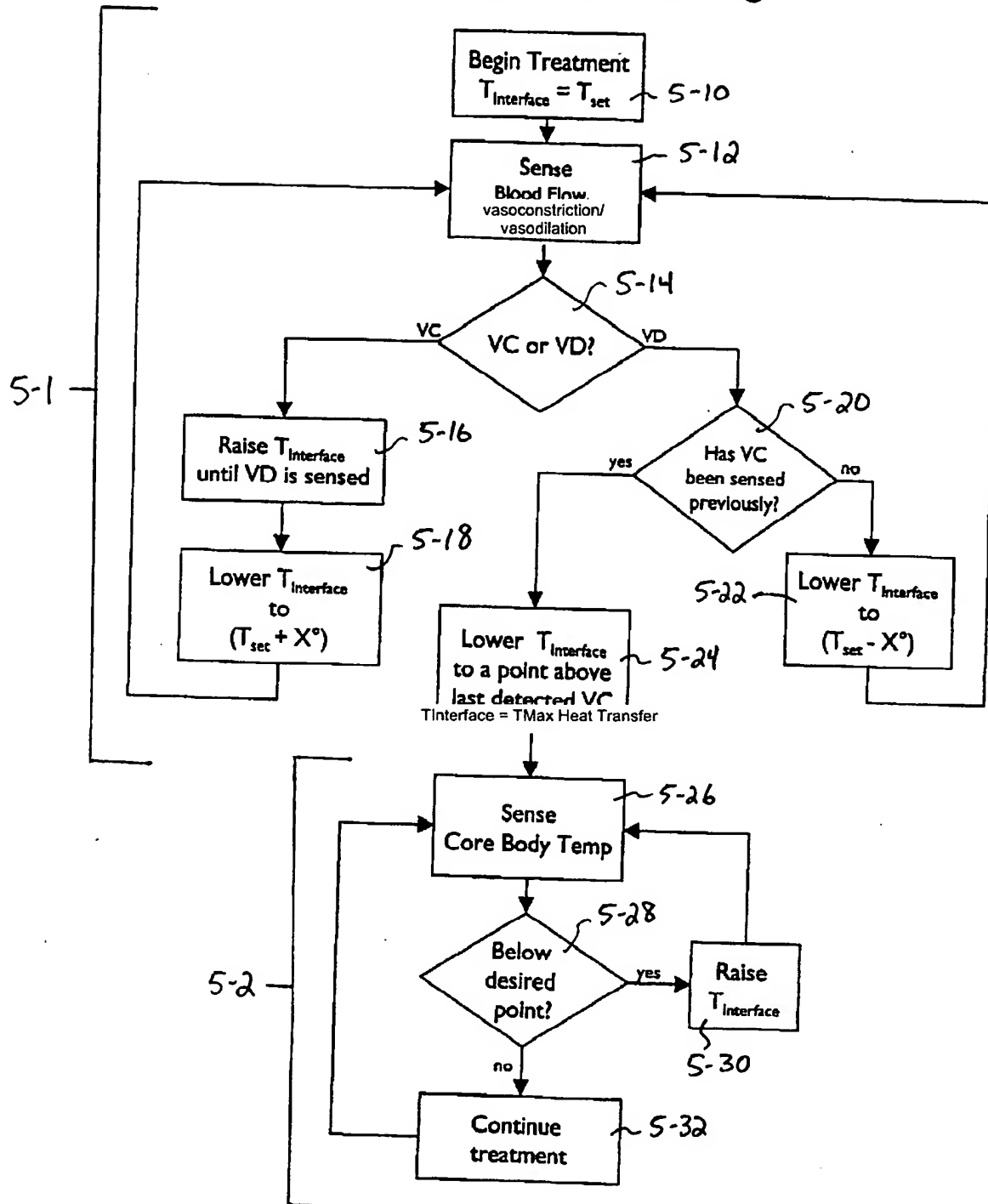
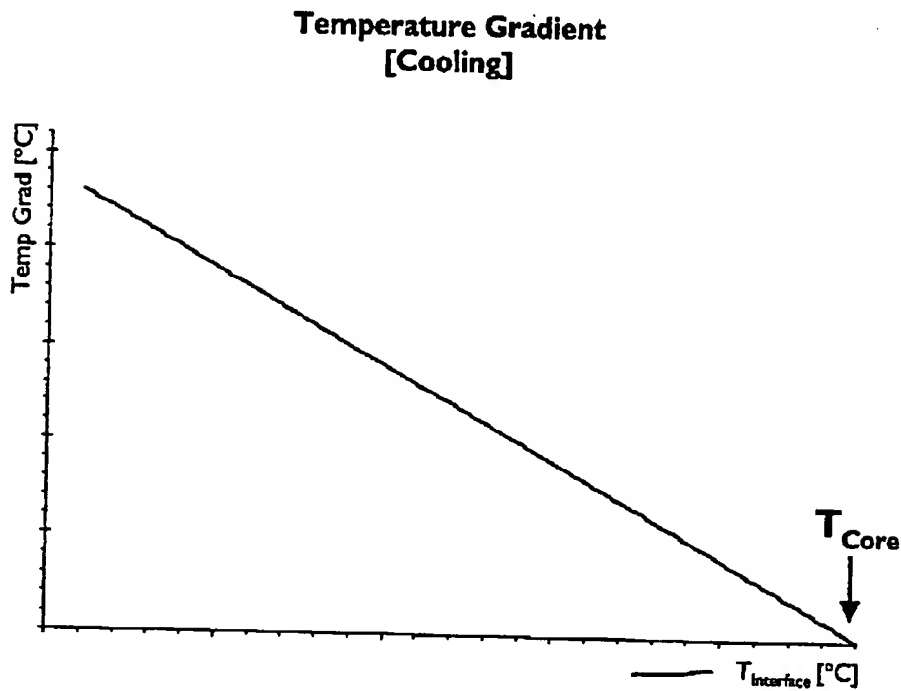


Figure 6

$T_{\text{Interface}}$ affects Vas c nstriction & Vasodilation



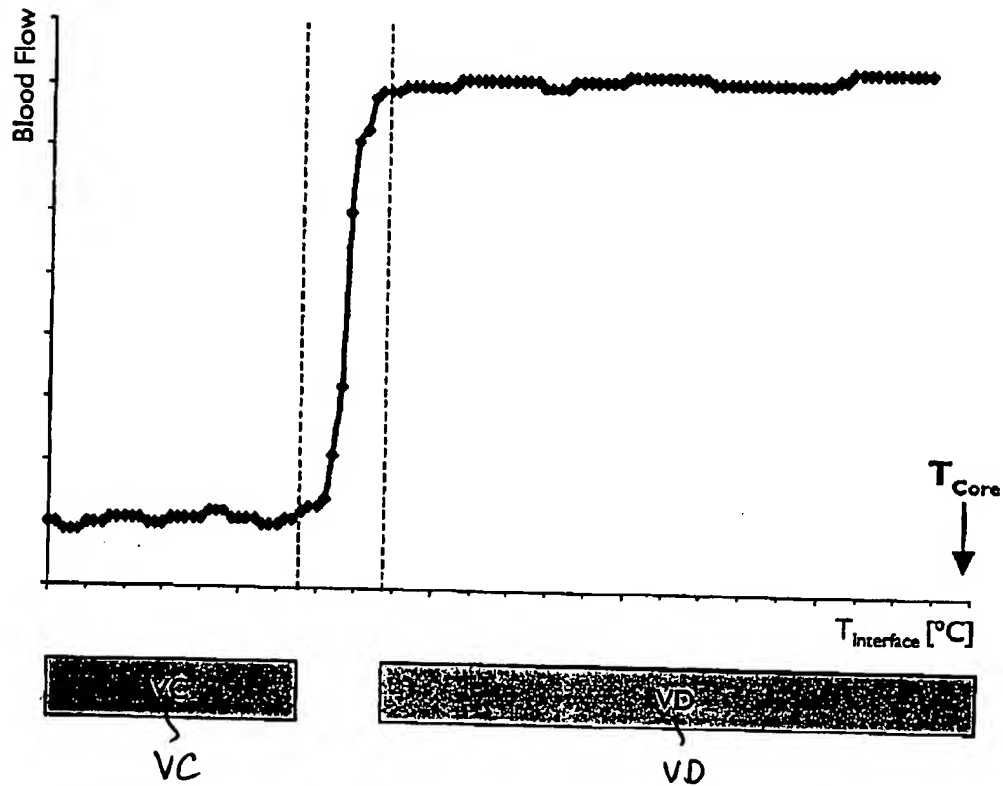
$$\Delta T \rightarrow \text{Temperature Gradient} \equiv |T_{\text{Core}} - T_{\text{Interface}}|$$

is the Driving Force in: **Heat Transfer
at the
Thermal Interface**

- **Cooling:** $T_{\text{Interface}} < T_{\text{Core}}$
- **Warming:** $T_{\text{Interface}} > T_{\text{Core}}$

Figure 7

**$T_{\text{Interface}}$ affects Vasoconstriction & Vasodilation
(as measured by Blood Flow)**



For each individual,

- Vasoconstriction [VC] occurs below a certain Temp range
- Vasodilation [VD] occurs above that Temp range

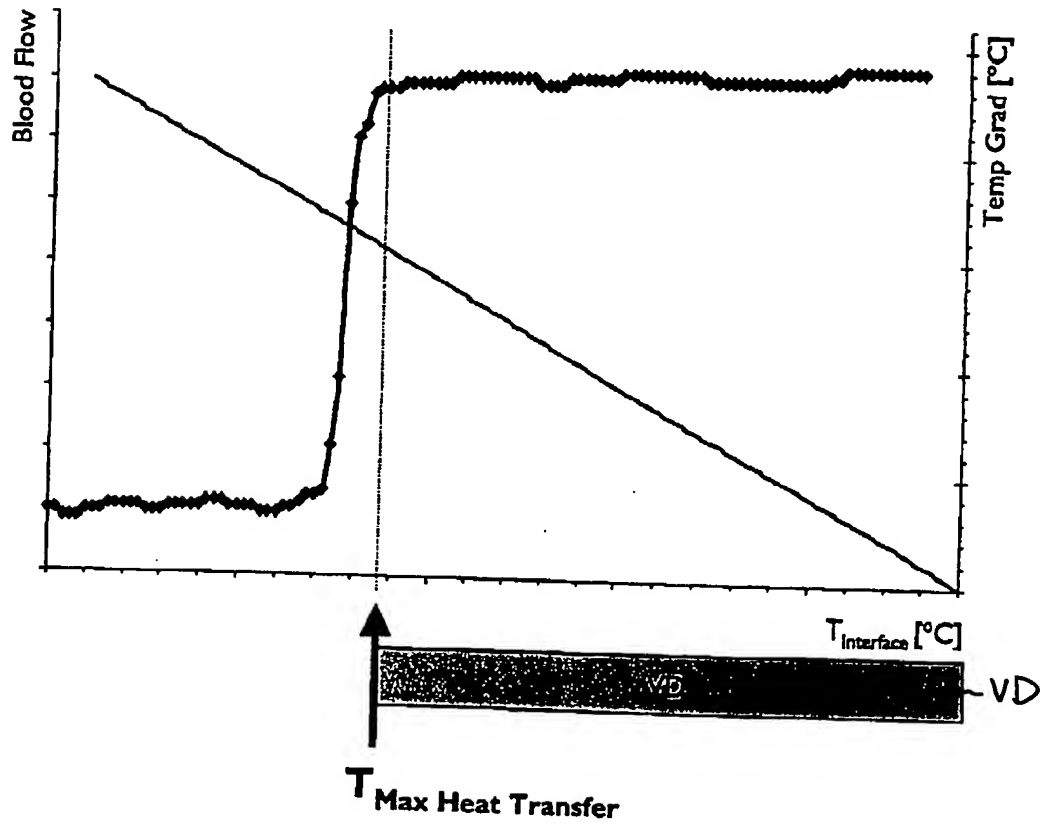
Blood Flow can be measure by:

- Laser Doppler
- Bio-Impedance
- Light Absorption (Pulse Oximetry)

Figure 8

$$\text{Heat Transfer} = f(\text{Temp Grad} \times \text{Blood Flow})$$

Figure shows Temp Grad & Blood Flow vs. $T_{\text{interface}}$ superimposed

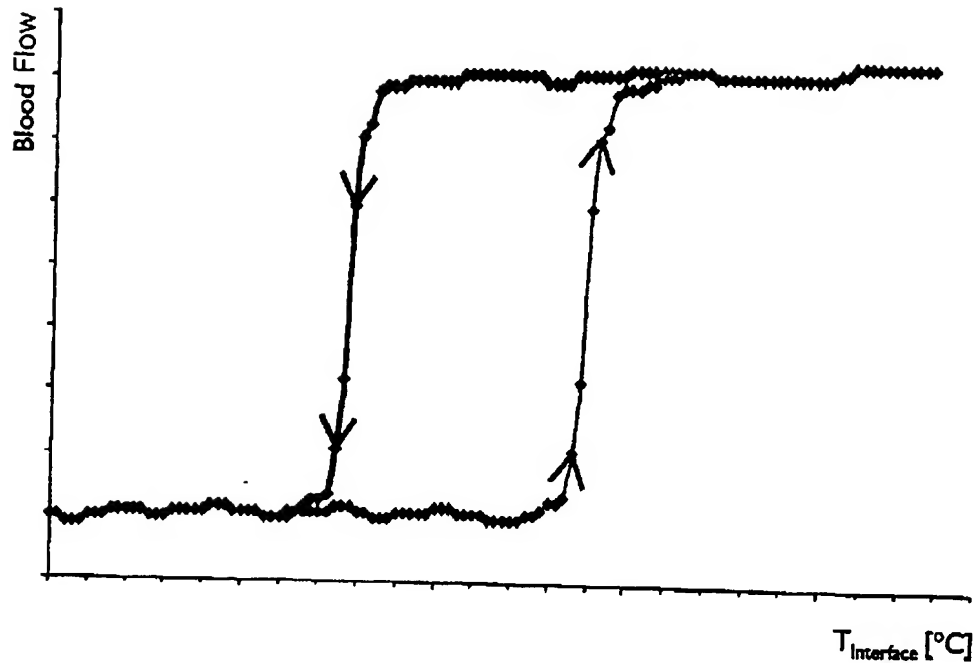


**Maximum Heat Transfer
occurs @**

**The lowest $T_{\text{interface}}$ where
Vasodilation occurs**

Figure 9

Hysteresis:



The transition between Vasoconstriction and Vasodilation is
NOT Identically Reversible...

The transition occurs at a different temperature range
depending on the initial condition

Typically, the transition from:

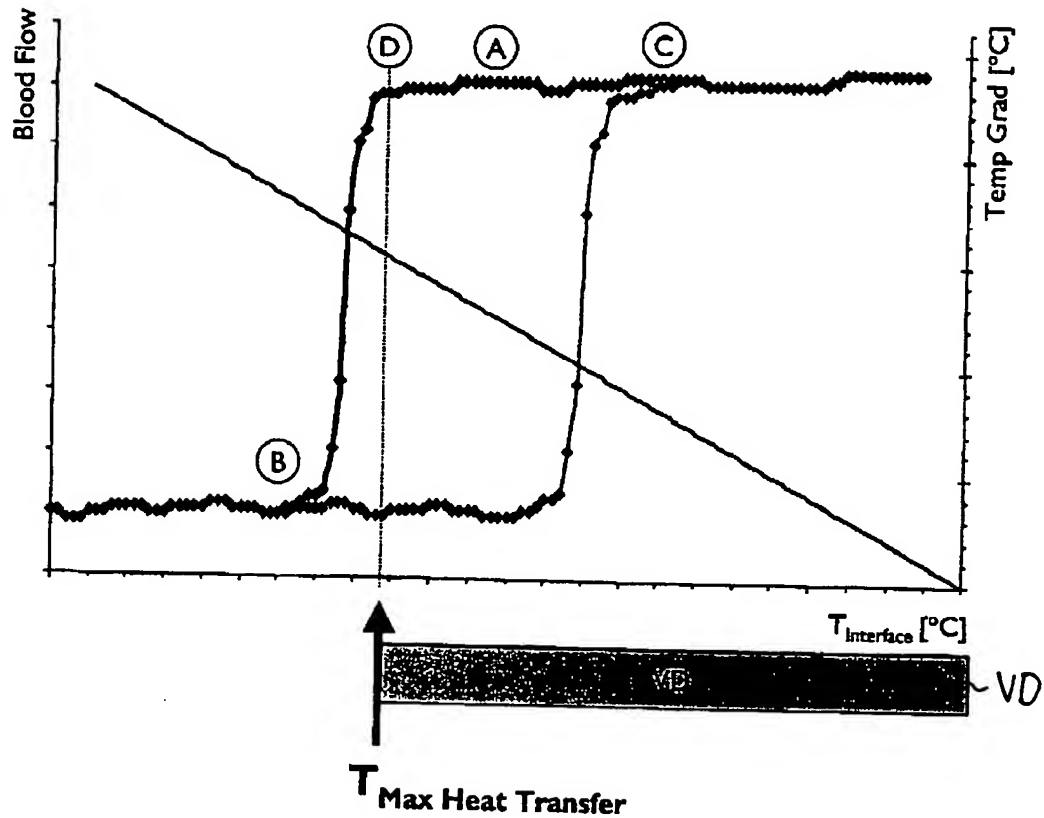
VC \longrightarrow VD

occurs at a $T_{\text{Interface}}$ range above

VD \longrightarrow VC

Figure 10

If Vas dilatation is initially detected

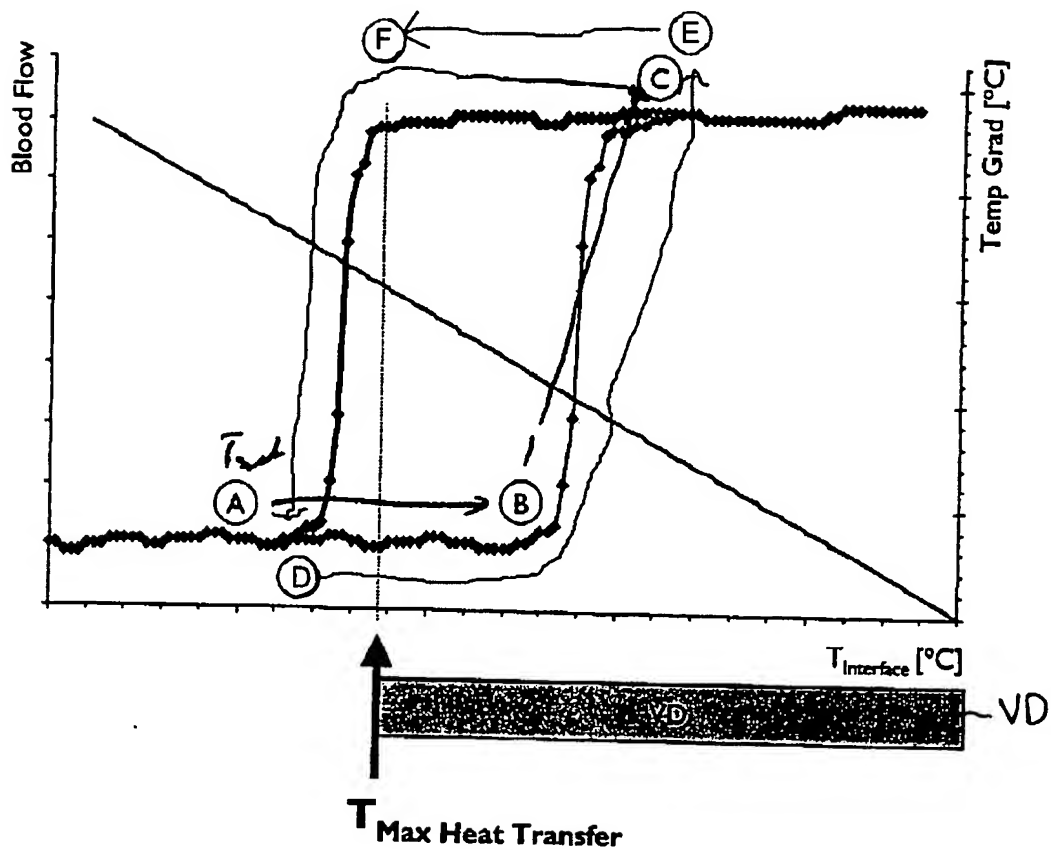


- (A) Blood Flow Sensor detects VD, $T_{\text{interface}} = T_{\text{set}}$
- (B) System controller decreases $T_{\text{interface}}$ until VC detected
- (C) $T_{\text{interface}}$ increases above transition temp range, VD occurs
- (D) System controller decreases $T_{\text{interface}}$ to $T_{\text{Max Heat Transfer}}$

$$T_{\text{Max Heat Transfer}} < T_{\text{set}}$$

Figure 11

If Vasodilation is initially detected



- (A) Blood Flow Sensor detects VC, $T_{\text{interface}} = T_{\text{set}}$
- (B) System controller increases $T_{\text{interface}}$
- (C) $T_{\text{interface}}$ increases above transition temp range, VD occurs
- (D) System controller decreases $T_{\text{interface}}$ to $T_{\text{Max Heat Transfer}}$

$$T_{\text{Max Heat Transfer}} > T_{\text{set}}$$